A PREDICTION OF THE FUTURE OF PROGRAMMED INSTRUCTION IN THE NAVY AND INDUSTRY

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A PREDICTION OF THE FUTURE OF PROGRAMMED INSTRUCTION IN THE NAVY AND INDUSTRY

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by

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ABSTRACT

Programmed instruction was first developed in the 1920's and has been used quite extensively since World War II. The increasing necessity for efficient and effective utilization of men, manpower and money requires the introduction, both in civilian industry and the Navy, of any tool which will accomplish this end. The use of programmed instruction by private enterprise is increasing and shows promise of helping to further achieve the profits by which success is measured. The Navy has made several effectiveness studies of programmed instruction. However, the recent developments and available courses point out many areas in which the Navy can benefit from civilian accomplishments.

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CHAPTER I

PART I. BACKGROUND

For most business corporations, the period immediately following World War II was exemplified by high consumer demands, a minimum amount of competition and excellent profits. Although the recession of 1949 eliminated some of the marginal producers, the high governmental expenditures of the Korean Crisis eased the competitive pressure. By the middle and late Fifties many firms had had to go through a serious self-appraisal of their management methods to determine the manner in which their competitive position and profit outlook could be best improved.

One of the functions which has of late come in for increasing investigation is the training of personnel. The "impetus of the "management trainee" program coincided with the influx of G.I. students to the labor market from about 1948 to 1955. In many cases the program existed in name only and therefore can be considered to have been only partially successful. In reality it was just another name applied to the training of the white collar worker. Most training of blue collar employees was loosely defined as "on-the-job training" with no formal training program involved.

Programmed instruction is one of the refinements that has been expanded upon since World War II in the effort to increase the return for the training dollar and/or to increase the output received for the same dollar input. As may be expected, not all corporations have had the same results with programmed instruction and many feel the nature of their business or the increased costs of initially installing some type of programmed instruction would exceed the benefits.

A review of the information available on the subject of programmed instruction and aids seems to fall into one of two categories. Experts support the use of programmed aids and instruction in its many forms. Its virtues are extolled in opinions ranging from acceptance as another worthwhile aid in performing a training function to advocating the teaching machine as the ultimate in educational instruction.

The opposite side of the coin is represented by the many people who feel that the lack of personal contact far outshadows the benefits that may be obtained through use of programmed instruction. As a result most of their animosity is focused upon the teaching machine because this method involves the least personal contact. Most of the information reflecting these views is to be found in publications covering the educational field. Rightly or wrongly many advocates of programmed instruction contend this opposition is due to an improper understanding of the

teaching machine and its use and the fear of job security by the marginal teacher.

The opinions favoring the use of programmed instruction can be found in several types of journals and periodicals. Educators, psychologists and industrial training personnel have all written articles advocating its employment. The fact that the "pro" rather than the "con" articles appear in special journals is understandable as their purpose is instructive rather than destructive. The "con" articles are usually to be found in popular periodicals or general opinion type periodicals.

Several misconceptions exist in the people's minds as to what programmed instruction is, what it will or will not do, how it is being used today and what are future predictions. It is not true that programmed instruction depends upon a mechanical device known as a teaching machine. Teaching machines are one method of presenting information. Depending upon the source of the machine it can vary from a cardboard frame to a complex electronic device. In addition to the hardware used to present the training, there are linear textbooks and scrambled textbooks as methods of presentation.

Many misinformed people, among them Educators and industrial trainers, understand the purpose of programmed instruction and the teaching machine is to eliminate the human instructor. This belief is definitely incorrect as

programmed instruction is intended to supplement training and free the instructor from some of the routine tasks. In this manner a better grade of instruction will result for more time may be devoted to complicated teaching duties and special assistance where required.

Another common misconception is that programmed instruction is designed primarily for the trainee who has had a minimum of formal education. This statement is definitely false. One only has to consult Appendix G to see that the courses vary from graduate level courses of a complex and technical nature to fundamental mechanical operations and basic information courses. The degree of formal education required for an industrial training course is generally related to the task and not the individual.

Contrary to many beliefs, a corporation does not have to be large or wealthy to use some form of programmed instruction. The amount of money invested is entirely dependent upon the form of training aid that is decided upon. Programmed textbooks are relatively inexpensive but some complex machines can cost in excess of $5,000 each. Therefore, the training director must carefully analyze his training situation in terms of: (1) objectives, (2) the types of people to be trained, (3) training dollars available, (4) number of people to be trained and, (5) how far are they from a central point where a teaching program could be established. This analysis will determine the

utilization that can be made of training aids and it may possibly reveal that programmed instruction is not the answer to the training problem. If it does survive this analysis, this examination will help in clarifying the real objectives and what it will take to achieve them.

While the amount of investment in programmed instruction need not be large it is equally true that the employment of this form of training will not reduce overall training costs. The claim that can be made, however, is that proper use of effective programs will improve the caliber and amount of training which can be offered.

PART II. STATEMENT OF THE PURPOSE

The purpose of this research paper is to draw conclusions as to the desirability of including programmed instruction in an industrial training program. These conclusions will be drawn as a result of a review of information which has been published on programmed instruction and an evaluation of the use and acceptance of programmed aids within industry. The evaluation includes a survey of: (1) industrial companies, (2) public utilities, (3) banking institutions, (4) merchandising concerns, (5) life insurance companies and, (6) selected transportation companies.

PART III. DEFINITION OF TERMS

For the purpose of this paper the following definitions and restrictions will apply:

PROGRAMMED INSTRUCTION--

1. A self-contained sequence of instructional

items which can be presented to individual students under controlled conditions. It is designed specifically to teach material and is repeatedly tested and revised until it gives consistent and acceptable results. The sequence of instruction items is generally presented in a series of small steps thus, permitting the learner to advance one step at a time to more difficult and complex materials as he masters the preceding material.[1]

2. LINEAR FORMS --

An unbroken sequence of small steps following a single track.[2]

3. FRAMES --

The unit of content of each sequential step in a program.[3]

4. PROGRAM --

Subject matter to be learned by self-instructional method; broken into bits and arranged in sequence leading to maximum understanding of the course.[4]

[1]David B. Story, "Programmed Instruction and Its Implication for the Training Section." Industrial Relations Training Section Bulletin of the Boeing Corporation. June 1963, p.6.

[2]R. David Niebler, "Programmed Instruction Saves Time -- and Grows." Personnel Journal, Vol. 41, No. 1 (May 1963) p. 240.

[3]Ibid.

[4]Business Management, "A Businessman's Guide to Teaching Machines, August 1962, p. 44.

5. EXTRINSIC PROGRAMMING --

A program sequence in which the steps are unalterable and identical for each trainee, not allowing for individual differences. (Linear program.)[5]

6. FEEDBACK --

After each of his responses, the learner is provided with information about the correctness, quality or appropriateness of his response.[6]

7. REINFORCEMENT --

The rewarding experience derived from immediate success in responding correctly to a frame.[7]

8. BRANCHING --

A program that has items built into it for either advanced or slow trainees. Alternate sequences give remedial practice and new explanations to misunderstood material. By this technique, faster trainees can skip certain material for additional or more advanced items on the same subject.[8]

[5] Ibid.

[6] Theodore B. Dolmatch, Elizabeth Marting, and Robert E. Finley, Revolution In Training Programmed Instruction In Industry, Management Report Number 72, (New York: American Management Association, 1962), p. 13.

[7] Niebler, loc. cit.

[8] Business Management, loc. cit.

[9] Niebler, loc. cit.

9. SCRAMBLED BOOK --

The branching system in book form.[9]

10. TEACHING MACHINE --

A mechanism that presents information to a student and controls his behavior in a pre-determined interacting relationship.[10] In order to meet the criteria as developed by the U. S. Department of Health, Education and Welfare a teaching machine must accomplish five of the seven functions listed below:

(a) Used for individual instruction.
(b) Contains and presents program content in steps.
(c) Provides a means whereby the student may respond to the program.
(d) Provides the student with immediate information of some kind concerning his response.
(e) Presents the frames of the program individually.
(f) Presents the program in a pre-determined sequence.
(g) It is cheatproof.[11]

11. PROGRAMMED TEXTBOOK --

The teaching machine in book form.[12]

[9]Niebler, loc. cit.

[10]Lawrence M. Stolurow, Teaching By Machine, (Washington, D.C.: U. S. Office of Education, HEW, Supt. of Documents, 1961).

[11]James D. Finn and Donald G. Perrin, Teaching Machines and Programmed Learning (Washington, D.C.: U. S. Office of Education, HEW, Supt. of Documents, 1962), p. 18.

[12]Niebler, loc. cit.

The conclusions that will be drawn as a result of this study will apply only to the field of industrial training. There will be no attempt to evaluate programmed instruction in the field of school education. In addition, industrial use of programmed instruction will be defined to include use within the Departmens of the Navy, Army, and Air Force for any phase of military and/or civilian training.

CHAPTER II

SUMMARY OF SELECTED RELATED SUBJECTS

PART I THE PRESENT DILEMMA

The point which is stressed most in any literature on programmed instruction is that regardless of the form it takes, the benefit to be gained from its use is dependent entirely upon the amount of effort and intelligence that were employed in developing the program.

Perhaps the greatest obstacle to expansion of the use of programmed instruction is the need for sufficient well constructed and tested commercial programs. Industry interest in programmed instruction is evidenced by the inquiries which Business Management received to a house article. In the August 1962 issue of Business Management a feature entitled -- "A Businessman's Guide to Teaching Machines" was run. Nearly 500 letters were received by the publication requesting further information on how to obtain specific training programs.[1]

The necessity for good programs was further substantiated in almost all of the questionnaires returned by corporations which are employing this method of training. In many cases this meant internal development. For example, the Equitable Life Assurance Society of the United

[1] Roger W. Christian, "Guides to Programmed Learning", Harvard Business Review, Volume 40, Number 6, November-December 1962. p. 36.

States had to spend months in planning, writing, testing and evaluating a twelve chapter 2500-frame program on "Life Insurance Fundamentals". It is true that some of the time initially spent in the planning function by Equitable was investigating the general field of programmed instruction and therefore would not have to be repeated. Never the less, the planning step will require study of such things as:

1. Problem areas requiring programs.
2. What programs are feasible (e.g. restriction because of the number of personnel to be trained).
3. How would this program fit into the over-all training program.
4. Select the source materials.
5. Type of training vehicle or hardware.
6. Programming technique to be employed.
7. Educational background of the trainees.
8. Educational objectives of the program.[2]

Many firms have developed fairly good cost estimates in both time and dollars for constructing their own programs. This information has been arrived at as a result on non-availability of commercial programs or the quality of those that were on the market did not meet the requirements of the company. Du Pont's experience is that it

[2]John T. Childs, "How to Develop Your Own Programmed Instructional Materials", (a presentation before the American Management Association Special Conference on Programmed Instruction in New York City on August 27 - 29, 1962.)

takes three man-days to produce the equivalent of one hour of classroom instruction. They also feel that if a course can be given to 100 people the cost is justified. Eastman Kodak's information indicates their programs take from 30 to 60 minutes a frame. An average program runs between 500 to 1500 frames requiring a minimum of 250 hours to a maximum of 1500 hours. IBM's records indicate that the ratio of development hours to programs hours is five to one.

Expressed in terms of dollars, estimates vary from a low of $4.00 per frame to a high of $30.00. To the development cost an amount has to be added for printing. The result is a total dollar cost that seldom will be less than $15,000 for a good 30-hour program.[3]

There are instances in which a training director will determine that it is not practical to have his program developed internally because there are commercial programs which will be adequate. In Equitable's case the program was tailored to fit their particular company requirements but a firm training a large number of employees in electricity, for example, would be able to select from several competent commercial developed programs.

Because the program is available on the market does not necessarily mean that it is good or will adequately

[3]Roger W. Christian, "Programmed Learning; Where it works, where it won't, what it costs", Factory, March 1962. p. 109.

perform the task for which it is intended. The planning step in this case is the thorough evaluation and actual pilot testing of commercially developed programs to insure the training needs will be fulfilled.

A well-planned text properly presented in many respects, approaches the situation of having a private tutor. Especially is this true when the students are well motivated -- are really anxious to learn. Certainly this is the situation in a large company where candidates are carefully chosen for a new endeavor in the organization, and they realize that a raise or promotion depends upon how quickly they learn the new task and become productive on it.[4]

[4] E. F. Cooley, "Automated Teaching", Computers and Automation, July 1962. p. 10.

PART II THE DEVELOPMENT OF PROGRAMMED INSTRUCTION

There are two schools of programming technique each based upon a different set of concepts of learning.[5] As teaching are one type of instruction aid and the theory that is employed is the same as that used in either programmed textbooks or scrambled textbooks,[6] the discussion that follows will deal primarily with the teaching machine.

The dominant school is headed by Dr. B. Frederic Skinner, Professor of Psychology at Harvard University. The second school is led by Norman A. Crowder, a former U. S. Air Force Psychologist, who is employed by the Western Design Division of U. S. Industries, Santa Barbara, California. Western Design manufactures and sells teaching machines and machine programs.

Skinner's method of programmed learning is the result of his work with animals, especially pigeons. By applying what he had learned to humans, Dr. Skinner developed a highly organized "linear form" method of teaching based upon the theory of "conditioning."

[5]George A. W. Boehm, "Can People Be Taught Like Pigeons?" Fortune, 62:177, October 1962.

[6]cf. ante p. 5

> The program is supposed to take the student by the hand, as it were, and lead him every step of the way through a course. According to Skinner, a good program makes it almost impossible for a student to make a mistake. The subject matter is atomized into tiny bits, presented to the student as a series of simple statements. Each idea is repeated over and over again, always in different words. Many of the statements include blanks to be filled in by the student with a word or two. The object is to have the student "participate actively in the program." By filling in the blanks correctly, he "conditions" himself to absorbing the information being presented to him.7

The key to this method, that of constant repetition, is additionally aided by testing after each frame. If the student has a correct answer he is rewarded immediately and allowed to go to the next frame. If he errs, he is required to repeat the last tiny lesson.

With the pigeons, the acts to be learned were taught one step at a time. Each time that the pigeon made a correct response, it was rewarded with a kernel of corn. It is a basic tenet of behaviorism that behavior patterns, such as learning, are essentially the same for all intelligent species.

Working from this premise, Dr. Skinner developed his first programs which he tried on undergraduate students at Radcliffe and Harvard University in 1957. As a substitute for the kernel of corn given to the pigeons, a psychological reward of feedback was given. By repeating the key word or phrase and allowing for feedback to the pupil three important concepts of psychology were put into play:

7Boehm, loc. cit.

1. Recall rather than recognition (recall is triggered by a minimum of cues and is considered to indicate a greater degree of retention than does recognition).

2. Reinforcement.

3. Feedback for the programmer. If a pupil is making too many errors at any point in a program, it is the program, not the student, that is held to blame.

Generally the machines used for presenting Skinner type programs are refinements of the original machine developed by Dr. Sidney L. Pressey, now Professor Emeritus at Ohio State University. In the mid-Twenties, when Dr. Pressey introduced his machine, his intention was that it would be used primarily in the field of school education. At that time teachers were a surplus commodity and there was no public pressure because of a teacher shortage or a Russian "Sputnik" to accept new methods of instruction. Even though the principal of the first machine has been carried over, the hardware in which it is contained has been changed considerably and comes in varities costing from $30 to over $5,000. In 1962 there were 84 machines listed by the Department of Health, Education and Welfare which met their criteria for school classroom instruction.[8] With the use of teaching machines or either type of textbook the three psychological concepts mentioned above are put into play.

Skinner believes that any subject which can be explained verbally can be taught effectively through pro-

[8]United States Department of Health, Education and Welfare. Teaching Machines & Programmed Learning. 1962. p. 18.

grams. This does not necessarily mean machines, although that is the method he prefers for presentation. He is of the opinion that such learned subjects as advanced mathematics are actually mechanical and are therefore subjects for programming and use within industry.

The validity of this reasoning is evidenced by the fact that the following courses in mathematics were reported in returned questionnaires as being used by industry: (1) General Mathematics, (2) Algebra, (3) Geometry, (4) Trigonometry, (5) Calculus, (6) Statistics, (7) Numbers, and (8) Boolean Algebra.

As indicated earlier, the program writer must understand both the process of learning and the subject matter to be taught. If this is accomplished the programmer can teach students to think deeply and perhaps originally. The program puts the student in contact with the programmer, who must be superior to the average teacher according to Skinner. The programmer through his programmed teaching will be able to influence a great many more trainees than training personnel can do under a conventional lecture type program.

While more and more psychologists and educators are testing and expanding the use of programmed instruction as advocated by Dr. Skinner, Norman Crowder is urging that his type of programmed instruction be accepted. He has found very little support among psychologists for his philosophy, which is based upon a non-behaviorist concept

of learning and resembles conventional teaching much more than does Skinner's. Instead of conditioning students to learn, he provides them with programs designed to serve as a private tutor. The basic difference is that Crowder dispenses much more information at one time, often several meaningful paragraphs to a frame, rather than atomizing this information.[9] Major differences are:

	Crowder	Skinner
1.	Dispenses large segments of material	Information given in small bits --repeated often
2.	Acts as a private tutor	Conditions students to learn
3.	Branching permitted	All steps in sequence --no skipping
4.	Permits mistakes (tries to anticipate them)	Makes it virtually impossible to go wrong
5.	May use a multiple choice type question	Trainee must construct answer

Although Crowder's theories have not had the acceptancy that Dr. Skinner's have, the former has been successful in having programs published in book form by Doubleday. The books, called Tutor-Texts, do not resemble conventional textbooks in that the material on page two does not follow the material on page one.[10] It may be from the middle of the course or the end. By scrambling in this

[9] Boehm op. cit., p. 259

[10] scrambled textbooks, cf. ante. p. 5.

manner it is supposed to reduce, if not eliminate, cheating by the student.

In 1960 Crowder was also successful in selling 18 of U. S. Industries' $5,000 AutoTutor machines to the U. S. Air Force. These machines were used at Keesler Field, Mississippi to teach fundamentals of electronics to airmen using a Crowder developed program.

Both psychologists are in agreement on two important points. The first of these is that the trainee is allowed to proceed at his own pace. This possibility permits those who have difficulty with any of the material being presented to move as slowly as necessary. At the same time, the person who is able to comprehend the training rapidly can move right ahead. In neither case would the trainee invonvenience any other student.

The second point on which Skinner and Crowder are in agreement is that the best vehicle for presenting programmed instruction is the teaching machine. They feel that a machine which presents the material frame by frame reduces cheating by the trainee. In the case of programmed instruction cheating has a somewhat different connotation than that we usually associate with the word. The object of programmed instruction is to teach not quiz a trainee. Therefore the lazy trainee who is working from a book or loose leaf papers is tempted simply to glance through or scan the material rather than seriously applying himself to finding the correct solution to the problem.

Even though there is agreement expressed in the above paragraph, programmed material need not be presented by machine to be effective. In fact, training directors returning the questionnaire seemed to favor some form of textbook presentation. Although no definite reasons have been given in most cases, it can be assumed that the initial cost of a machine installation is the factor that rules out machines.

PART III - A POSSIBLE SOLUTION FOR THE TRAINING DIRECTOR

A training department competes with all other departments for funds or is supported by the departments benefiting from the trainee's instruction. In either case management finds it difficult to approve the disbursement unless it can be proven that the number of trainees and the reoccurrence of the need warrant the expenditure.

Regardless of the preferred method of presenting programmed instruction, it is the answer to three industrial training problems. According to J. L. Hughes and W. J. McNamara of the International Business Machines Corporation, industry has always suffered from a shortage of qualified instructors. Generally speaking, this may be attributed to the fact that the industrial trainer is a highly skilled specialist, perhaps even a psychologist, but he lacks formal training in the field of education. His unintential mistakes in technical educational areas can destroy much of the value of his training course. Another associated matter faced by the industrial instructor is inadequate time for lesson preparation as a result of the number of classes it is necessary to conduct to meet a training deadline.

Secondly, the number of persons to be trained is so small that required training must be deferred until enough trainees are available to justify the cost. A related problem faced by many training departments is the manner of conducting training for second and third shift

personnel. Regardless of the solution, the trainee is seldom satisfied by having to put in paid overtime to receive the instruction.

The third problem is that of training employees from a plant who work in widely dispersed locations within a metropolitan area. Bringing the trainees to a central location involves considerable expense in transportation and time away from the job. For a detailed and lengthy course there is often no acceptable answer other than hiring additional personnel.

These three problems can be significantly alleviated by programmed instruction. Because the new training package of educational material makes a self-sufficient package of educational material available to each trainee, it reduces the need for qualified instructors in many courses and allows the company to train its employees individually and at any time and place. Beyond this, programmed instruction offers the possibility of training employees more quickly and more effectively than traditional methods allow.[11]

There's a feeling in programmed instruction circles that any teacher who can be replaced by a machine should be.

[11] J. L. Hughes and W. J. McNamara, "The Potential of Programmed Instruction," Personnel, Nov.-Dec., 1961, p. 63.

A number of industrial instructors, and even training directors, are certainly inadequate enough to qualify.[12] Any training director who has the foresight to insure that an efficient program is properly used need not fear for his job, for the effectual employment of these tools can only enhance his position with his superiors.

Military training is somewhat different again. The expenditure by the Air Force in excess of $100,000 for 18 AutoTutors and programs at Keesler Field is much easier to justify. As is the case in training of military airmen in fundamentals of electronics, most trainees are going through a training cycle with a large group. The machines can be effectively utilized during the day and the continuous input of personnel in such a program results in a low per pupil cost for instruction equipment.

Training personnel in industry have indicated that it is practical to develop programs for those jobs in which you have "conformity learning". Generally speaking this breaks down into these five general types:

1. Rote memorizing (procedures, names, fixed rules)
2. Job skills (lubrication, filing system, credit policies)
3. Problem solving (training assembly line inspectors, quality control)

[12] Christian, "Guides to Programmed Learning," op. cit., p. 37.

4. Mastering concepts or generalizations (algebra, slide rule techniques, PERT)

5. Pattern recognition (assembly line jobs, sorting)[13]

To those training situations falling into the above categories several advantages accrue. It must be emphasized that it is not necessary to scrap a good program presently in force to gain these benefits. Most of the successful industrial training departments have supplemented, not replaced, a competent program. In this manner they have been able to measure greater effectiveness, a consistency in instruction and dollar efficiency of training. For many of the larger corporations these accomplishments are combined with a degree of decentralization of training not previously possible. By bringing the training to the trainee when it is needed per diem costs often associated with instruction are reduced if not eliminated. A variety of indirect benefits[14] have been recognized but accurate measurement of many is not possible.

The outstanding, and probably most successful, program described in the references is the assembly line operation which Hughes Aircraft Company has installed.

[13]Christian, op. cit., p. 110.

[14]e.g., improved supervision, higher morale, better defined training goals.

Hughes installed over 1,000 Videosonics in production lines in Tuscon, El Segundo and Fullerton. The pilot test was run in 1958 in the Tuscon plant on a Falcon Missile assembly project. The results of this test were a reduction of production defects ranging from six to thirteen per chasis at the start of the test to 0.06 per chasis within a ten month period, a reduction of 99%.

The Videosonic combines visual presentation with tape instruction. The hardware resembles a portable TV set. The visual presentation is on a 35mm. film strip and is synchronized with a magnetic tape recording. A set of headphones completes the unit and one set is installed at each bench position on the assembly line. In this assembly process one operator completes an entire assembly rather than doing just one mechanical task. The speed of presentation is controlled by the operator and she is allowed to take as much time on each sequence as she feels necessary.

The initial program, used when a new chasis or a new operator comes on the assembly line, gives detailed procedures and includes warnings of possible problem areas based upon production defects encountered in the past.[15] When the operator is efficient enough to speed up the operation an abbreviated tape is used. This tape covers the operation but does not go into the detail as much as

[15] e.g., cold solder joint, a solder splash, reversed components, insufficient clearance between components, etc.

did tape one. It does repeat the warnings that are required to keep the product up to standard as concerns quality control. The super-short version, sometimes referred to as the "Bikini", would just hit the major points as a brief outline would do for a book review.

The drastic reduction of defects was only one of the benefits that Hughes obtained. Output was increased in all cases, as the realization rate between standards and production was increased from 60% to 90% and 100% on a consistent basis. Others factors of note were: (1) by reducing variables attributed to individual operators, production is much more standardized, (2) a special qualify control group that acted as a check and test unit was eliminated entirely, (3) supervisors, who previously had been devoting almost all of their time to training, were now able to concentrate their efforts on managing personnel, and (4) engineering changes could be introduced in a matter of hours rather than days as had been the case previously.

Hughes also determined that the same type of program could be designed for operations such as machine shop and tube testing. The testing operation required the use of a cathode ray oscilloscope for comparing wave shapes with those of suspect tubes. Colored slides showing the exact wave pattern desired were used to make comparisons with the actual tube being tested. The effective testing time was reduced from just under five hours to 17 minutes.

> On one assembly line making a critical intermediate frequency amplifier, it previously required about four months for an operator to get up to the line's average realization of about 53% of the work standard. After Video-Sonics was installed, Hughes transferred a new operator from the wire harness line into the IF amplifier line. By the end of the first day she had achieved a rate of 80% of the work standard.[16]

Hughes Aircraft has now entered the teaching machine production field because of their success with the Video-sonic. The amazing results cited above could be the claim of an enterprising sales manager except that they were cited in several periodicals in 1960, prior to the time that the decision was made to enter the teaching machine production field.[17]

[16] Philip J. Klass, "Video-sonics Cuts Production Defects", Aviation Week, Vol. 72, Part I, January 4, 1960. p. 77.

[17] Klass, op. cit.,pp. 75-79; and Business Week, "How Machines Do Teaching Job," September 17, 1960. pp. 111-114.

CHAPTER III

PART I. THE GROUP SURVEYED

The large amount of information available on programmed instruction in use in industrial operations would lead one to believe that it has been widely accepted. In order to either prove or disprove this assumption it was necessary to conduct a survey of industry.

In trying to determine who should be included in the survery, further research was required to find the common ground upon which a decision to use programmed instruction could be based. The first idea that came to mind was the cost of the tools and hardware. When a review of prices revealed that teaching machines ranged from $25 to $5,000 and textbooks were available from $3.00 up it was evident that this could be, at best, only a partial answer.

A second point was the size of the labor force but this did not seem to insure the use of programmed instruction either. Meat packing and food processors employ large amounts of untrained labor but would not be good candidates for programmed instruction purchases. The automotive industry has tremendous labor rolls however, it was doubtful if they would be required to spend much money to bring workers to the level that he could fit pieces together, insert bolts in predrilled holes, spot weld, tighten nuts, etc.

The size of the company was another factor to be considered. This was tied in again with cost of the pro-

gram and there did not seem to be any definite coorelation. Nor did the type of business seem to be the key to employment of programmed instruction.

As long as there did not seem to be any one factor that could be applied, what combination of factors would satisfy the requirements? The following elements seemed to apply to some degree in most cases, although not all were applicable or to the same degree in any given instance:

1. Number of employees to be trained
2. Repetitive nature of the training
3. Size of the company
4. Cost of the program -- including aids and hardware
5. Type of business
6. Present size of the training function
7. Management outlook, and
8. Business success.

There did not seem to be any way in which it would be possible to select, at random, a list of diverse corporations that would meet the requirements.

Because of this the annual listing contained in the Fortune magazine of the largest corporations, from point of sales, seemed to fit most of the necessary elements. Even though it did not include small concerns, it seemed upon consideration that they probably would not qualify on many of the points. Their budgets would not permit the large initial expenditure and the number of employees

to be trained would be on an almost individual basis after completion of the elementary training.

The Fortune listings of the largest companies based upon sales did not necessarily guarantee such things as profit, success, forward looking management or adequate training. It did insure inclusion of diverse industries, different size labor forces, companies that ranged from individual processing by skilled artisans to large assembly line operations, both white collar and blue collar training, and seasonal operations employing considerable itinerant and manual laborers.

The questionnaire[1] was sent to the Director for Training of the following concerns doing business in the United States:

1. 500 largest industrial corporations
2. 50 largest commercial banks
3. 50 largest life insurance companies
4. 50 largest utilities
5. 50 largest retail merchandising firms, and
6. 37 selected large companies.

The answers received revealed that many of the large utilities were, in fact, holding companies. In many instances the questionnaire was forwarded to the largest of the utilities within the company for an answer.

The 37 selected concerns reported in item 6 above were airlines, railroads, bus operators and over-the-road truckers also reported in the August 1963 issue of Fortune.

[1]See Appendix A.

Some large companies do not release figures in regard to their business and therefore, they could not be ranked by Fortune. I included any large concern in this category that I knew from past experience was not on the list.[2]

[2] e.g., Cargill, Inc. of Minneapolis, Minnesota.

PART II-THE QUESTIONNAIRE

My primary purpose in sending out the questionnaire was to determine the extent to which programmed instruction was being used and what forms of aid were employed. I did not attempt to determine the cost of programmed instruction for I felt that this factor might make many concerns hesitant about revealing any information.

Each firm was given the opportunity to reveal its corporate identity only if it so desired. Many companies did reveal their identity but asked not to be quoted by name in the study. 131 companies returned questionnaires which did not list the company but their receipt contributed immeasureably to the results of the survey. Most of the companies in this 131 did not use or evidence any interest in programmed instruction.

The firms and organizations listed in Section D of the bibliography all submitted additional information with their completed questionnaires. This type of assistance was appreciated and contributed to the development of the subject. Several individuals volunteered to assist in the research for my paper if they should be needed.

The answers received in the survey far exceeded expectations. Based upon past experience it was felt a return of 15 to 20 percent was very good. If the returns were between 10 and 20 percent, figures could be developed statistically to make predictions for the study. 737 questionnairs were sent out and 504 returns, or 68 plus

percent, were returned in a two and one-half month period. One company wrote a two page letter explaining why they could not answer the questionnaire and another company made any answers contingent upon receiving a copy of the research paper.

47 Companies requested a copy of the paper when it was completed. This group included companies which:

1. Had programs installed and desired the information for improvement of their own programs,
2. Had a definite interest but had not installed a program as yet, and
3. Did not have the program and it was necessary for the training director to do a selling job with management.

An attempt was made to obtain a company evaluation of their programs in respect to: (1) training effectiveness, (2) dollar effectiveness, and (3) method in which it was used.

Realizing that the questionnaire could not elicit all the information which might be useful, the last portion was available for comments, either pro or con, which would contribute to the research paper.

QUESTION	YES	NO	OTHER REMARKS
Can answers to survey be quoted?	246	97	161 not marked
Has Feasibility study been conducted?	139	20	345 not marked
What method of PI used?			88 teaching machine 193 programmed text 25 scrambled text 9 other
How is PI used?			217 supplement lectures 74 alone
Has PI permitted reduction in training personnel?	26	104	59 reduction
Does trainee proceed on own?	126	21	
Is training compulsory?	108	85	
Is training conducted during working hours.	68	48	

Figure 1. Survey Answers
(See Appendix D)

PART III - APPRAISAL OF THE RETURNED QUESTIONNAIRE

In order to properly examine all facets of the question in line with the statement of purpose,[3] each subject in the survey will be considered separately. The questionnaire in Appendix D from which figure 1 was taken, has been filled in with the quantitative answer received in the survery.

Of the 504 returned inquiries, 49 percent or 246 granted permission to quote any information they gave. 161

[3] cf. ante p. 5

were not marked and in those cases it was assumed that they did not desire to be quoted by company name. Of the 97 negative answers 22 identified their company and gave their name and title in question 2.

Question 3 was poorly worded for it was assumed that a study would have been conducted in all cases before programmed instruction was introduced. Several training directors indicated that this was not true for their decision to use programmed instruction was based upon information received from other sources.[4] As others pointed out, the results of the studies were not always in favor of the introduction of such a program. 24 firms indicated they were awaiting results of a study conducted by their own training department, by an outside organization surveying their company, or information furnished by a professional organization.[5] There were 139 companies which declared they had conducted studies as to the feasibility of installing programmed instruction and 20 disclosed they had not conducted their own survey prior to the use of this type of training aid.

[4] e.g. Many life insurance companies indicated the decision to use programmed instruction for sales training and product knowledge was the result of the evaluation of previous studies conducted by the Life Insurance Agency Management Association.

[5] See Appendix C, Chart II, Line 3.

18.4 percent, 7 out of 50, of the Life Insurance Companies were awaiting results of a study. This information was given in an address at the Life Insurance Agency Management Association annual meeting in chicago, Illinois the week of November 11-15, 1963. In his address Dr. Wallace, Vice President -- Research, of LIAMA said:

> LIAMA did show that agents who have more knowledge (of life insurance) tend to have a higher persistency of business than those with less.
>
> It seems apparent that what is needed here is some method by which we could improve the general knowledge level of our agents and, at the same time, free our managers from an activity which they do not like or are not particularly well suited for and give them more time to do the sales training which is, or should be, their major interest and responsibility.
>
> How to accomplish the release of managerial time without lowering our knowledge level? For some years, your research staff at LIAMA has been concerned with this problem. We have been closely following the work which has been progressing on what are called self-instructional techniques. There are many varieties of such techniques and some considerable differences in the theoretical structure upon which they are based.
>
> Thus far, most of the investigations of self-instructional methods have been made in the school (grammar, high, and college) or the armed forces setting. Generally, it has been found that for basic school subjects and for such knowledge areas as electronics, weapon systems, etc., the self-instructional approach can make dramatic improvements in the knowledge level reached and in the time required to reach it. In fact, in the educational world there is some worry that the technique will replace the teacher too thoroughly--a concern which, fortunately, we need not share.
>
> This evidence was strong enough to encourage us to investigate what this technique might do for our industry and, because most of the successful applications have been in the field of knowledge and because our problem in the area of basic life insurance knowledge I mentioned earlier, we decided to see what could be done there.
>
> We have invested a very considerable sum of money, LIAMA staff time, and time of agents, managers, and home office staff of some wonderfully cooperative companies in a research project to evaluate the self-instructional technique in life insurance setting.[5]

[5]S. Rains Wallace, "Steps Into Life Insurance." Presentation made before the Life Ins. Agency Management Association at the 46th annual meeting. November 14, 1963. P. 4, 6-7.

Dr. Wallace went on to tell how thoroughly they had developed the course and recommended its use for the improvement of salesmen's knowledge, an increase in sales and a freeing of the agency sales manager for other duties.

If the decision of the seven insurance companies referred to above hinged upon the recommendation or lack of recommendation by LIAMA, it would seem that they will consider introduction of programmed instruction in their training.

Question 4 (a) requested information on whether teaching machines were used and if so, who were the manufacturers and what were the models. 88 respondents indicated they were using some form of teaching machines.[6] There were 19 different models listed that could be identified as to type and manufacturer. They varied from the moderately priced machines using printed media and requiring a written response to complex digital computer programmed and computer controlled psychomotor devices. The number of machines which each company had was not requested and eight of the companies failed to identify the model or manufacturer of their machines.

A percentage of 48.6 of the companies using programmed instruction used some form of teaching machines. The comments concerning the advisability of teaching machines in a training program varied considerably. Mr. Harold Z. Mason, Manager Station Training, Trans World Airlines:

[6]See Appendix E.

> Teaching machines -- absolutely not!! While we do not have starts in our eyes, we are excited about programmed instruction. We are totally disinterested in teaching machines at this stage of development of same. We can, however, teach more in less time with PI. PI will never completely replace:
>
> 1. A teacher or instructor,
> 2. Student demonstration of skills, and
> 3. Need for student contact with a specialist.

On the other hand a Corporate Director, Manager Development and Training of an industrial firm reports:[7]

> We have 32 teaching machines of 11 different types for use in our five divisions. Each serves a special purpose and is an extremely valuable addition to our training facilities. In addition, we use programmed and scrambled textbooks. We have not replaced any training personnel by using any of these aids but we have doubled the efficiency of our teaching and are able to adequately handle many more employees.

Mr. Robert E. Goche, Vice President, Greyhound Corporation expresses his opinion of teaching machines in this statement:

> Western Greyhound Lines, a division of Greyhound Corporation headquartered in San Francisco, is the first of our divisions to utilize teaching machines. Their acceptance of the Edex response teaching machine is excellent and the results have been extremely gratifying.

As can be seen from the above quotations there is a great difference of opinion concerning the value of teaching machines even among advocates of programmed instruction.

[7]The Training Director quoted requested that he and his company not be identified by name other than the fact it was an industrial concern.

Question 4 (b) dealt with programmed textbooks. The programmed textbook resembles a regular school text in that the material is presented in logical steps and does not require the student to skip from page to page. The method of communication, however, does differ from the ordinary textbook. The material is presented in short paragraphs and the trainee is tested upon the completion of each small unit before going on to another point in the program. In other words, the book becomes the hardware similar to the teaching machine.[8] The survey indicated 193 programmed textbooks were being used. 46 companies denoted they had developed one or more of the texts which they were using and 125 were purchased from publishing concerns.[9] Appendix F lists 26 concerns cited as publishers of the textbooks being used. In addition to those publishers, "Teaching Machines and Programmed Learning"[10] list several additional companies supplying programmed texts.

Texts for all courses are not available on the open market, 108 corporations employed consulting firms that developed courses especially for their use. The 712 courses reported in the survey, both in-house and commercially prepared, have been listed in Appendix G. As can be seen some would have limited application while others could be employed by almost any concern requiring instruction in the

[8] cf. ante., p. 8.

[9] See Appendix E and F.

[10] U. S. Department of Health, Education & Welfare. Teaching Machines & Programmed Learning. Office of Education. 1962.

topic. Many of the programs that are developed by consultants are modifications of a general course designed to the specific requirements of the firm. Indications are that this type of change is relatively inexpensive while the complete development of a program will require a considerable expenditure of time and manpower.

Professional and trade organizations, such as the American Management Association and the American Institute of Banking, have entered the programming field also as an aid to members. This is possible with courses such as "PERT" and "Cost Reduction and Control for Supervisors" which would have general application in most industries. Manufacturer developed programs, similar to the International Business Machine Corporation's computer courses, are for use with a particular product regardless of the industry employing the training aid.

The acceptance of scrambled textbooks has not been up to that of the regular programmed texts. Only 25 scrambled textbooks were indicated as being used. 6 were developed by corporation training divisions, 8 were purchased from outside consultants and 14 commercially published programs were used. Inasmuch as this totals 28 and only 25 texts were reported as being used, I assume that some texts were developed by training departments in conjunction with outside consultants.

The cost of scrambled texts considerably exceeds that of the regular programmed textbook. One text covering a

complex operation is quoted at $152. Perhaps this accounts for the fact that commercial publishing concerns have not rushed into this type of printing. The scrambled text is a modification of the Crowder theory.[11] I believe the relatively small usage is a reflection of the increased purchase cost and not on the value of the text as a method of instruction.

The 9 types of programmed instruction reported under question 4 (d) were taped instruction. These were not described in detail so it is not known just what form these take. If it is just the use of a tape recorder to supplement a classroom lecturer, it is doubtful if this could properly be considered programmed instruction.

The answers to question 5 are reported in Appendix G. In order to eliminate the listing of many similar titles, courses have, in some cases, been grouped under a general heading.

In answer to question 6, which asked how the programmed instruction was used, 217 companies indicated the programs were supplementing classroom lectures and 74 employed the programs as the sole instruction aid. As only 181 companies indicated the use of programmed instruction, the replies have to be related to the 306 instruction instruments.[12] Using this base, 71 percent are using the programmed instruction as a supplement and 24 percent use it as the sole

[11] scrambled textbooks, cf. ante., p. 18.

[12] 88 teaching machines, 193 textbooks and 25 scrambled textbooks.

med instruction as a supplement and 24 percent use it as the sole training device. There were many comments to the effect that programmed instruction should not be the only method employed and others that indicated certain courses would not require any additional assistance:

1. L. R. Lenarz, Manager, Production & Industrial Engineering, The Magnavox Company -- Courses in "electronic wire and solder training" and "inspection training" must be supplemented with lectures but "employee indoctrination" and "manufacturing processes" are complete unto themselves.
2. H. O. Holt, Director of Training Research, American Telephone and Telegraph Company -- "Basic electricity" is a self-contained package although some operating units are adding lab exercises; WATS and 20-40 DIALPAK (sales training) are self-contained.
3. K. R. Berkheimer, Supervisor, Electronics Training, Lockheed-California Company -- Our courses are for background training and skills upgrading (Calculus, Sets, Introduction to Electronics, Trigonometry, etc.) are used independently at present. A variety of approaches will eventually be used on courses that are to be added to our training program.
4. Thomas F. Higgins, Assistant Training Director, John Hancock Mutual Life Insurance Company --

Some of our courses teach a cross section of employees with limited insurance knowledge the knowledge of the fundamentals of life insurance. Others are used for teaching computer programmers the basic principles of the IBM 1401 programming and staff personnel the PERT technique. They are used as the sole teaching instrument, except computer programmers also received formal classroom instruction in programming electronic data processing equipment.

From this and other similar statements, I think it can be safely said that whether a particular program is used as the sole method of instruction or is supplemented by some form of personal instruction will depend upon the subject and the group being taught.

In answer to the question regarding a possible reduction of training personnel 26 companies, 14 percent, indicated they had been able to reduce a total of 59 personnel as a result of the introduction of programmed instruction. 104 or 57 percent indicated that there was no reduction in personnel. However, many qualified their answer in the following manner:

1. Robert E. Britton, Director, Sales Training, The Seven-up Company, St. Louis -- No, not the intent of the program as nothing has been replaced. Programmed material has been added to, and integrated into, present training programs with no additional personnel required.

2. Selwyn Brent, Education Consultant, UNIVAC (Div. of Sperry Rand Corp.) -- Immediately no, but long range training staff reduction is more important. Systems Analysts double as instructors and this allows them to concentrate on Systems Analysis.
3. Robert Brink, Instructional Programs Supervisor, General Telephone Co., of California -- No, but time saved is applied to other supervising requirements.
4. Harry G. Woodward Jr., Manager, Training Services, Interstate Bakeries Corporation -- No, but more training is done and there is no increase in the training staff.

It would seem from these remarks that the total training dollars probably will not decrease but the value received for the training dollar will be larger than had been the experience prior to the introduction of programmed instruction. If a larger group may be trained the cost per trainee could be reduced.

Question eight had to do with the method of instruction, specifically, was the student allowed to proceed at his own pace. The overwhelming answer to this question was Yes. 126 or 70 percent were allowed to pace themselves and 11 percent, 21, were kept to a class pace. There was no indication given as to what courses were included in the 21 negative answers.

As question nine consisted of four parts requiring a narrative answer, rather than one which could be answered by Yes or No and be quantified. Some of the most significant replies were:

1. Can you cite results of effectiveness or lack of effectiveness of programmed instruction vs. lecture training?
   a. Ralph W. Walker, Supervisor, Programmed Instruction Unit, Martin Co. (Denver)-- YES, our programmed instruction Titan II Familiarization course yielded a 9.3% increase as measured by the same criterion test.
   b. J. J. Stadtherr, Training Director, The Pure Oil Co. -- Definitely more interest shown in self development at all levels.
   c. J. Howell Staley, Assistant Vice President, The Philadelphia National Bank -- Our employees have reacted enthusiastically to programmed instruction, and studies made by our Loan Department reveal much better retention by those who have taken the P.I. course.
2. Can you cite any results of savings or lack of savings in training hours and/or dollars?
   a. F. L. Docken, Training Director, The Maytag Co., -- We have definitely proven that P.I.

will save training hours on wire harness training by operating people.

b. Robert R. Royce, Training Consultant, Atlantic Refining Company -- Saves a few minutes of supervisor's time, but what is more important, insures trainees get taught simple tasks that the supervisor is apt to forget.

c. C. W. Flanders, Corporation Manager Training, Sprague Electric Co. -- Isolated training problems have been solved and spot training may be done easier and faster.

d. Ralph W. Walker, Supervisor Programmed Instruction Unit, Martin Co. (Denver)--Yes, the Titan II Familiarization course yielded a 30% student savings when administered to site and field personnel. Also a 34% reduction in students time.

3. Can you cite results of training cost per student or course of instruction with programmed aids vs other forms of training?

a. George L. Germain, Supervisor - Development & Training, Lukens Steel Company -- About 18 hours of training time per student saved versus a relatively inexpensive course cost per student (AMA's Cost Reduction and Control for the Supervisor) because they do the

program on a voluntary basis on their own time. It holds their interest and makes "homework" more challenging.

b. Everett L. Smith, Coordinator of Training, Sunray DX Oil Co., -- There is a much smaller cost involved on the amount of programmed instruction being used at this date.

c. Norman R. Miller, Training Supervisor, Westinghouse Air Brake Co. -- If off the shelf programs can be used, there is a tremendous savings in course development time for classroom instruction.

d. Bennett Dolan, Training Systems Manager, Security First National Bank of Los Angeles --Permits high quality training in outlying branches; not economically possible any other way.

4. Can you cite any results of employee attitude of lecture type training as contrasted to programmed instruction?

a. Walter E. Gaipa, Associate Director of Field Training, Field Training Div. -- District Agencies Dept., Prudential Insurance Co.-- Trainees overwhelmingly prefer P.I.

b. James H. Kearney, Training Assistant, The Mead Corporation -- Trainees desired more of this type of training plus wanting more advanced courses.

c. John H. Stetson, Director of Training, First National Bank of Boston--From the instructor's standpoint there is a noticeable difference in the understanding of the group to the subject matter presented --because the trainees have the background, through the Programmed Instruction, to follow more easily the application to their situation.

d. R. W. Rolfe, Chief, Education and Training, Northrup Norair -- Early questionnaires indicated 25% preferred lecture, 25% had no preference, and 50% preferred programmed instruction. Findings at this time indicate that programmed instruction will offer more complete subject mastery and greater class flexibility at lower cost.

e. Dale R. McCracken, Industrial Engineer, Champion Spark Plug Co. -- Programmed training is accepted much more readily by employees.

The following answers were received to question ten regarding the manner of conduction the programmed instruction:

		Number	Percent
1.	Compulsory	108	59.6[13]
2.	Voluntary	85	47.0[13]
3.	If voluntary, approximate % of participation	18 cited percentages ranging from 10% to 98%. Avg., 61%.	
4.	On a continuing basis	61	33.7
5.	Upon initial employment	52	28.7
6.	Whenever an employee is introduced to a new function or process	41	22.8
7.	At regularly scheduled periods.	47	25.9
8.	During non-working hours	48	26.5
9.	During working hours	21	16.1[14]

In the quotations I have given from the returned questionnaires, I have, of course, presented a biased picture taken from the 36 percent who have advised that they are using programmed instruction. I endeavored to select those answers which answered the question best and avoided, wherever possible, more than one quotation from the same source. It was hoped that this last factor would better indicate the acceptance of programmed instruction and at the same time point out some limitations.

Question eleven requested additional comments, either pro or con, which would contribute to the research project.

[13]Overlap in the above instances is due to multiple courses being offered within a company of either category. Had the question been answered by all 181 corporations the overlap would have been considerably larger.

[14]This question was not specifically asked but 21 indicated that instruction was conducted during working hours. My guess would be that the answer to the question would have been approximately 75+ percent indicating an overlap again.

Inasmuch as many of the best comments are also from the persons who have been previously quoted, it will be necessary to repeat some of the sources in order to present a complete picture:

1. Philip P. Miller, Assistant Vice President, Director of Training, Crocker-Citizens National Bank. --Under programmed instruction there is a renewed interest in training that is not evident under lecture type training.
2. Dean D. Osborne, Supervisor of Development and Training Supervisor, E. W. Bliss Company -- We could write programmed instruction but time is of the essence. Like color TV, texts will be forthcoming at a reasonable figure. Our company developed a program over a year and one half period and now a text is available on the market.
3. Clarence W. Glud, General Training Supervisor, Rayonier Incorporated.-- Seems to be of most value for individual instruction when the size of the class would not justify the expense of an instructor. Some students are able to fit their studies into slack periods during working hours rather than be taken away from the job when urgent work assignments are pending.
4. Jack D. Robb, Manager of Training, McDonnell Aircraft Co. -- I feel the programmed text is good but must be supplemented with film, discussion

periods, lab (where applicable) and tests to determine achievement. It is erroneous to believe the text, in most cases, by itself distributed to a group will be effective.

5. Gordon M. Rhodes, Assistant Cashier, Personnel - Operations, First National City Bank of New York City -- We are completely satisfied with efforts in Programmed Instruction over the past three and one half years. We no longer utilize outside consultant companies but instead have an internal programming section consisting of three programmers and one clerk with the intent of further utilization of programmed instruction as an adjunct to our conventional training methods. In all areas of utilization, students achieve completion of the course material in shorter periods of time and attain maximum trainee output in approximately 50% of the time it formerly took.

6. R. E. Silver, Training Director, Micro Switch Div., Honeywell Corporation -- To date, we have mainly used programs of general nature in basic areas (slide Rule, Calculus, Memo Writing, PERT). One man has been prepared to write programmed material. As of now he has one short program on solder training completed. We feel that well done programs properly applied will pay real dividends to any company working in the training area. We still are

of the opinion that tailored or modified programs are too costly for most small sized training jobs.

7. George L. Germain, Supervisor - Development & Training, Lukens Steel Company -- The way a program is used is as important as the program itself. No training, programmed or otherwise, will be very successful without active interest of management and proper, continuing follow-up.

8. James M. Yasinow, Training and Development Advisor, Cleveland Electric Illuminating Company -- I believe programmed instruction has its place, but it is only one tool of many available to trainers. Although some trainers are flocking to programmed material as though it were a panacea, I do not share their unbounded enthusiasm. We use programmed materials quite selectively. Much of the programmed material available today I consider to be overpriced. Much of it is of real value, in terms of reduced training time and effective results. If it meets a need, then programmed learning can do a job. Material which doesn't meet your need is worthless.

9. Ralph E. Giles, Assistant Director - Personnel Development Division, Continental Oil Company -- The refinery operator is a shift worker, because of a degree of automation, the operator's presence is required but he is not busy all of the time -- only when the unit is upset, or starting up, or coming down.

When an operator is pulled off the job for classroom instruction, he must be replaced by holding over the operator of the prior shift for half of the vacant shift, and calling out early the operator from the following shift for the other half of the vacant shift.

This means overtime! Manhours in classroom cost time and a half! Programmed instruction permits technical upgrading of operators on the job without interference with normal duties at no cost beyond the materials.

Programmed instruction has not only reduced time and dollar cost of old training, but permitted new training that was formerly prohibitive in cost.

10. Ralph E. Boynton, Vice President, Training Department, Bank of America -- The accelerating requirements for employee development programs have been generated primarily by organizational growth and technological change. Meeting these requirements demands that traditional instructional methods receive substantial subsidization from media which (1) utilize the proven principles of programmed instruction, and (2) incorporate the inherent advantages of audio visual applications.

The Bank of America is presently investigating the feasibility of extending the application of these techniques to a variety of other areas, including

teller training, proof machine operation, and international banking. It is emphasized that programmed instruction, teaching machines, et al, are regarded as a means for more adequately supporting, not replacing, instructional supervision.

11. F. M. Nadolny, Supervisor, Training and Accident Prevention, Duquesne Light Company -- We started programmed instruction in subjects where best applicable. This type instruction ensures that all the details are covered, however, we often supplement with lectures to clarify certain points. We have found programmed instruction very effective for our type training and plan to develop additional courses.

I have cited in Part III, 38 executives who are directly concerned with training. In order for them to have made the statements I have quoted, it was necessary for them to have evaluated the companies' training requirements and goals, the available methods and the cost and effectiveness of the methods. 18 different industries are represented in this group to give as large a cross section as possible.

712 courses have been programmed by or for 181 commercial enterprises. If these successful firms feel that the dollars expended for training contribute to profit, it can be assumed that there is a value to be gained from using programmed instruction.

The Training and Education staff of the Industrial Rela-

tions Department of the Mead Corporation conducted a survey in early 1963 similar to this one. They sent 133 questionnaires to randomly selected companies in several industries. Of the 71 replies received, 29 or 41% reported the use of programmed materials. This is just a bit more than the percentage (39%) that answered affirmatively in this study. There were differences in some of the details but the coorelation between the two independent studies was remarkable.[15]

A similar study made in mid-1962 by Gordon L. Lippitt and Wayne N. Schelle and reported in the Journal of the American Society of Training Directors in November 1962, revealed that only 20 percent of the members of the Society were using programmed instruction selectively or only occasionally.[16] It is not known how many of the organizations contacted in this study are members of the American Society of Training Directors. It would not be unreasonable to assume that most of the companies would have been included in my list of 737 corporations.

[15]Rex F. Sheets, Dom Ramirez and James H. Kearney. "Programmed Instruction." Notes from a panel discussion presented to the Annual Conference of the American Society of Training Directors, May 6, 1963.

[16]David B. Story. "Programmed Instruction and Its Importance for the Training Section." Industrial Relations Training Section Bulletin of the Boeing Corporation, June 1963. pp. 9.

I feel that this is an indication that the number of firms realizing the value of this media has increased and will continue to do so in the future.

The factors limiting the use of programmed instruction in the Lippitt and Schelle study were:[17]

1. High initial cost
2. Small population to train
3. Low turnover
4. Not suited to work involving judgmental complexities
5. Programs not available which are needed or easily adapted
6. Rapid obsolescence causing rewriting of programs
7. Difficulties in programming
8. No existing need
9. Lack of interest

Some of these reasons were cited in the negative returns received in this research questionnaire, however, the reason for not using programmed instruction was not directly requested. The 34 returns, which indicated a study had been conducted and the results disclosed that the introduction of programmed instruction would not be practical, gave as a reason a variation of 1 through 9 above.

Further information received in Society of Training Directors survey concerned the attitudes towards programmed instruction and the advantages and disadvantages

[17] David B. Story. "Programmed Instruction and Its Importance for the Training Section." Industrial Relations Training Section Bulletin of the Boeing Corp., June 1963. pp. 10.

attributed to automated teaching. The summary of these were as follows:[18]

ADVANTAGES OF AUTOMATED TEACHING

Advantages	Responses	%
Standardized instruction	78	27
Faster learning	68	23
Increased retention	42	14
Increased learning	42	14
Cost reduction	25	9
All of these	31	11
None of these	6	2
Total	292	100

LIMITATIONS AND DISADVANTAGES

Disadvantages	Responses	%
Difficult to program the mat'rl	105	38
Impersonal & loss of human element	98	35
Higher Cost	51	18
Lack of student interest	13	5
None of these	6	2
Length of training	4	1
All of these	3	1
Total	280	100

The necessity for adequate programming of material was stressed in the earlier part of this paper.[19] As to whether or not this should be listed as a disadvantage is questionable.

18 Ibid., pp. 13.

19 cf. ante., p. 10

Because a task associated with training methods is difficult to perform or unfamiliar, it should not necessarily be a criteria in determining the value of the media. It is the end product which must determine the advisability of implementation. These same disadvantages listed above appeared in my study. In my opinion the advantages, in both studies, definitely outweigh the disadvantages. Therefore, I feel that the results of the two studies cited above further substantiate the results obtained from the questionnaire sent out in connection with this research paper.[20]

[20] See Appendix A

CHAPTER IV

NAVY EXPERINCE WITH PROGRAMMED INSTRUCTION

The use of programmed instruction could have potentially important sugnificance in military training. Military trainers are faced with a short span of training time as well as a heterogenous group of trainess. It is doubtful, however, if the trainees would be decidedly different thatn would be experienced by a large corporation at one of the plants employing in excess of 5,000 people. The selection process for technical schooling in the Navy is supposed to be based upon a psychological evaluation of such things as the General Classification Test and other aptitude tests that are given. Supposedly a person with just above borderline intelligence would not be selected for a technical shcool requiring considerable mathematical skill. On this assumption, it may be conculded that the bulk of the technical trainees have the intellectual ability necessary to attain some measure of success.

The United States Navy has made several evaluations of teaching machines and programmed textbooks. The first use of a teaching machine occured during World War II. A "pinball" type machine was used for teaching aircraft recognition and rules of the road in an effort to accelerate instruction. The student was given a multiple choice question on a punched plastic card and was to press a button corresponding to his selection. A correct answer received a green light allowing the student to go on to the next question and at the same

time registering a numerical score which took into consideration response time. An incorrect score meant a red light and the student was to make another choice. The effectiveness of the machines was never scientifically proven and due to cost and maintenance problems the machines were not utilized following World War II.

The work being done by Skinner and other educational psychologists in the late 1940's and early 1950's renewed interest in the teaching machine as an instruction aid. The U. S. Naval Training Devices Center has undertaken several studies as well as contracting with civilian institutions for research in the field.

An early project by the NTDC was the design and field testing of the "Green Light Rater" in 1958. Basic considerations of the device are practicality and psychological validity. The Green Light Rater is inexpensive, adaptable to physical environment of trainees, requires minimal maintenance, and has the advantage of allowing the using activity to prepare and install its own questions. Trainees are presented with an array of forty two (six rows, seven columns) of 3" x 5" cards. Each card has a multiple choice question with four alternative answers and a row of correspondingly numbered buttons below the card. Buttons glow red if incorrectly pressed and green if correct. Its psychological validity is based on incentive motivations, knowledge of results, repetition, contiguity, distribution, incidental learning, and lack

of stress. As to its value as a method of presenting material for review, it is more of a "gimmick" than a training aid or device.[1]

Another test was conducted by the Guided Missiles School, Dam Neck, Virginia in an effort to determine if the attrition rate at the school could be reduced. Six of the Auto Tutor Mark II Machines (projected media/key response) were made available for the use of the students for remedial and refresher training in algebra, trigonometry, electricity and the use of the oscilloscope. The machines were used for a one week period employing off the shelf programs rather than Navy developed and oriented material. The value of the machines was not conclusively proven. It was surmised that there was some benefit but no attempt was made to document and statistically support that supposition.

The British Navy did conduct controlled evaluations of the Auto Tutor and Tutor Texts for Naval instruction in trigonometry to compare automated and human instruction. Three groups, one using the Auto Tutor, one using Tutor Texts (a scrambled textbook) and one receiving conventional classroom lectures, were given a six lesson syllabus to be completed in a nine hour period of instruction. The groups were pre-selected on the basis of prior education, mathematical ability as determined by testing, age, and intelligence quotient.

Both groups using the programmed instruction completed their six lessons in less than the nine hours allotted (a mean of 5.6 hours for the Auto Tutor and 5.5 for the Tutor

[1]Caling, S. C. "Teaching Machines for Navy Use." A research paper submitted to the U. S. Naval Postgraduate School, Oct. 1962.

Text) while the classroom instruction group was able to finish five lessons in the nine hours. Examinations at the completion of the course showed grades slightly higher for the Auto Tutor group but it could not be called significant. A reexamination designed to measure retention conclusively proved that the retention rate of either of the programmed instruction groups was substantially superior to the classroom group.

Based upon the controlled factors and method in which the test was conducted, it should be safe to assume that the test did indicate an advantage in length of learning time and retention of programmed instruction over human instruction. A questionnaire given the three groups did reveal that the programmed trainees felt they preferred the conventional teaching methods. This was especially true in the case of the group using Tutor Texts.

An experiment similar to this was conducted at the U. S. Naval Service Schools Command, Great Lakes, Illinois by a research psychologist from NDTC using Min/Max machines, a printed media written response type machine. Courses for AC electricity, DC electricity, refresher mathematics and calculus were evaluated under the following conditions:

1. A comparison of programmed instruction and closed circuit television. (As an aside the Dept of Health, Education,& Welfare considers closed circuit television can be classed as a form of programmed instruction.)[2]
2. Programmed learning as compared to human instruction.

[2]U. S. Dept. of Health, Education, and Welfare. Teaching Machines and Programmed Learning. Washington D.C.: Ofc of Education, U. S. Dept. of Health, Education, and Welfare, 19621 p. 49.

3. Effectiveness of assignments outside class using programmed texts and conventional texts.

It was generally concluded that the results obtained in this experiment were similar to those obtained by the British Navy. The effectiveness of instruction as measured by retention was relatively the same when comparing programmed instruction to what are considered convential methods of instruction. In the area of instruction time it was quite evident that time savings were possible using the programmed instruction type methods and materials. The group using the programmed texts gained a significantly increased grasp of the material in the assignments outside the classroom environment.

An Evaluation of all Navy conducted experiments by the Engineering Psychology Branch of the U. S. Naval Research Laboratory revealed that programmed instruction in the Navy has one of the same faults as proven conclusively in civilians trials. If the program being presented has not been carefully and effectively prepared the value to be received is next to nothing.[3] It was decided that any Naval activity engaged in training could give the maximum training in academic subjects in the minimum time if programmed instruction were employed. The additional time available to instructors could be utilized in constantly improving the programs. Further, it would allow instruction based upon exception -- that is devoting instructor time to problem areas rather than routine matter which could be conveyed by use of programmed instruction.

[3]Birmingham, H. P., R. Chernikoff, and P. N. Ziegler, "An equalization Teaching Machine." Naval Research Lab. Rpt. 5855, Nov. 1962. pp. 6.

CHAPTER V
CONCLUSIONS

It is estimated that U. S. corporations now spend as much as $2 billion a year to train their employees -- for American Telephone and Telegraph alone the bill is well in excess of $75 million. The three million non-college graduates predicted to need professional and technical training in the next ten years may have to rely in part, on industrial instruction.[1] Programmed instruction will be expected to bear an increasing amount of the training load for it is not just another in a long list of training fads. Proper evaluation should be made of its place in the training structure and the director must insure selection of adequate materials. This medium seems to have promise when assigned a proper niche. Confidence is being placed in this instrument to assist in solving such problems as unemployment and the training of displaced labor resulting from the continual changing technology.

This study has shown that programmed instruction, in its many forms, should be an asset in most training situations. It is not a cure-all but it has a place when properly evaluated and adequate programs are utilized. It is doubtful if a reduction of training expense will result if programmed instruction is used, although the amount of training and the educational value of the training should increase when equated

[1]Spencer Klaw, "What Can We Learn From The Teaching Machines?" The Reporter, July 19, 1962. p. 23.

to the cost of programming and associated hardware. However, with a significant number of trainees the cost per trainee could be considerably reduced.

It is my opinion that the Bureau of Naval Personnel and the Naval Training Devices Center could profitably investigate some of the courses presently being offered to commercial industry. There are definitely several commercial courses that would have a high coorelation with training courses being offered enlisted men as a requirement for promotion.

It would seem that the installation of some type of inexpensive teaching machine aboard naval ships and stations for presenting programmed training courses would have a potential of increased training at a cost very little in excess of present expenditures. With the present trend in reduction of petty officer advancements, it is essential that the increases in rate go to those who are best qualified.

If the caliber of the candidates and the interest displayed could be increased through programmed instruction, the Navy might find that it has an assist in some of the problems set forth in the Dillion Report (e.g. adequate maintenance).

Increased retention in technical rates such as those involved in the repair of electronic instruments, gyroes, radar, etc., would tend to offset the additional cost. In the clerical rates such as storekeeper, yeoman, and personnelman the amount of information dispensed could be increased having a multiple affect in amount of retention, one of

the benefits of programmed instruction.

With additional training the talent now employed in developing the training courses could possibly be channeled into programming. The cost of training programmers would be minor when it is spread over the number of personnel participating in the training programs leading to advancement in rate.

In conclusion, it would seem that the advantages of and benefits to be gained from programmed instruction, both in the Navy and in civilian industry, indicate future growth. The objective would be to use programmed instruction as an adjunct to present training aids. As the science of training progresses, under proper conditions program instruction will contribute a greater share to its efficiency.

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APPENDIX A

U. S. Naval Postgraduate School
Box 2654
Monterey, California

Dear Sir:

As a partial requirement for a Master's Degree in Management at the U. S. Postgraduate School, I am conducting a research project in the application of programmed instruction aids in Industrial Training.

The attached survey is being mailed to the following Corporations:

a) 500 largest U. S. Industrial Corporations (as listed in the July, 1963 issue of FORTUNE magazine).

b) 50 largest U. S. Commercial Banks.

c) 50 largest U. S. Life Insurance Companies.

d) 50 largest U. S. Merchandising Firms.

e) 50 largest U. S. Utilities (b, c, d, and e) as listed in the August, 1963 issue of FORTUNE magazine.

I would sincerely appreciate your completing the questionnaire and returning it in the franked self-addressed envelope. Any additional comments you might wish to make concerning programmed instruction will be welcomed.

If your firm does not use any type of programmed instruction aids, I would still appreciate a return of the questionnaire, marked with this fact, to determine the extent to which these aids are being employed. If a study has been conducted which indicates it would not be practical to use this type of training aid please indicate this fact in the remarks section, #11, of the questionnaire. If programmed instruction has been employed previously and then abandoned as not being practical please indicate in #11.

QUESTIONNAIRE FOR USE IN A SURVEY OF

THE APPLICATION OF PROGRAMMED INSTRUCTION AIDS

IN INDUSTRIAL TRAINING

1. May the information given in this questionnaire be quoted in the research paper? No attempt has been made to code any survey form.

   YES_____

   NO_____

2. If the answer to #1 is YES, please give your name, title and firm name.

3. Has your firm conducted a study into the feasibility of employing programmed instruction?

   YES_____

   No_____

4. If YES in #3 above, what type of programmed instruction is employed?

   a) Teaching Machines_____

      1) Manufacturer_____

      2) Model_____

   b) Programmed textbooks_____

      1) Subjects_____

      2) Developed by your training department_____

      3) Developed by outside source (e.g. John Jones, Consultant)_____

      4) Purchased from publishing concern_____

         1a) Publisher_____

         2a) Author_____

c) Scrambled textbooks_____

1) Subjects_____

2) Developed by your training department____

3) Developed by outside source (e.g.John Jones, Consultant)_____

4) Purchased from publishing concern_____

1a) Publisher_____

2a) Author_____

d) Other Type_____

1) Manufacturer or Publisher_____

2) Subjects_____

5. For what type of instruction is the programmed aid used? (e.g. Prudential Life Insurance Co., uses teaching machines for instruction of sales personnel; Hughes Aircraft uses teaching machines on electronics assembly line process; Schering Drug Corporation uses programmed textbooks for proficiency in drug knowledge for sales personnel; Bell Telephone Laboratories for introductory electricity; Humble Oil Company for service station operation training; etc.).

6. Is the programmed instruction used to supplement classroom instruction or used solely by itself?

7. Has the employement of programmed instruction permitted a reduction of personnel used for training?

YES_____

NO_____

If YES. How many_____

8. Is the student allowed to proceed at his own pace?

YES_____

NO_____

9. Can you cite any results of:

a) Effectiveness or lack of effectiveness of programmed instruction vs lecture training._____

b) Savings or lack of savings in training hours and/or dollars_____

_____

c) Training cost per student or course of instruction with programmed aids vs other forms of training._____

d) Employee attitude of lecture type training as contrasted to programmed instruction, etc._____

10. Is the training conducted (check all that are applicable):

a) Compulsory_____

b) Voluntary_____

c) If voluntary, approximate percentage of participation_____

d) On a continuing basis_____

e) Upon initial employment_____

f) Whenever an employee is introduced to a new function or process

_____

g) At regularly scheduled periods_____

h) During non-working hours_____

11. Any additional remarks, either pro or con, which you feel would contribute to the research project.

APPENDIX B

1. Total Sample Size - 737

1) 500 Largest U. S. Industrial Corporations.[1]
2) 50 Largest U. S. Commercial Banks.[2]
3) 50 Largest U. S. Life Insurance Companies.[2]
4) 50 Largest U. S. Merchandising Firms.[2]
5) 50 Largest U. S. Utilities.[2/3]
6) 37 Selected Concerns.[4]

[1] FORTUNE, "The Fortune Directory -- The 500 Largest Industrial Corporations," July 1963. p. 177-196.

[2] FORTUNE, "The Fortune Directory -- Part II," August 1963. p. 139-150.

[3] 17 of the Utilities listed in Fortune advised they were holding companies. Of this number 8 passed the questionnaire to a subsidiary corporation for reply and 9 returned the questionnaire marked "not applicable because the number of employees would not support the use of programmed instructions.

[4] Included Airlines, Railroads, and other transportation concerns, and large corporations not listed in Fortune because they do not divulge financial information.

2. Questionnaires returned -- 504	#	% of Sample	% of Returns
a) Programmed instruction is being used	181	24.5	36.0
b) A study is being conducted but results are not yet available	24	3.3	4.7
c) Study is being considered and/or definite interest by corporation	51	6.9	10.1
d) A study has been conducted. Results indicate that introduction of programmed instruction would not be practical[5]	34	4.6	6.7
e) Programmed instruction is not being used, there was no indication a study has been conducted, and no interest shown.	214	29.0	42.5
Returns	504		100%
f) No reply	233	31.6	
Total Sample	737	100.0	

[5] Reasons listed were (1) too few employees

(2) too expensive to implement

(3) not enough repetitive elements to warrant the expense of developing a program, etc.

APPENDIX C
CHART I

Questionnaire Return Recapitulation:

	Number Sent Out	Number Returned	% of Sample Returned	% of Total Returns by Class
1. Industrial	500	249	49.8	49.4
2. Banks	50	30	60.0	5.8
3. Life Insurance	50	38	76.0	7.6
4. Utilities	50	37	74.0	7.5
5. Merchandising	50	19	38.0	3.7
6. Miscellaneous	37	N/A[1]	N/A[1]	N/A[1]
Total Question	737			
7. Unknown		131		26.0
Total Returns		504	68.4	100.0
8. No Reply		233	31.6	
		737		

[1] Miscellaneous figures for Columns 2, 3 and 4 are included with Industrial.

CHART II

Breakdown by Answer and Class

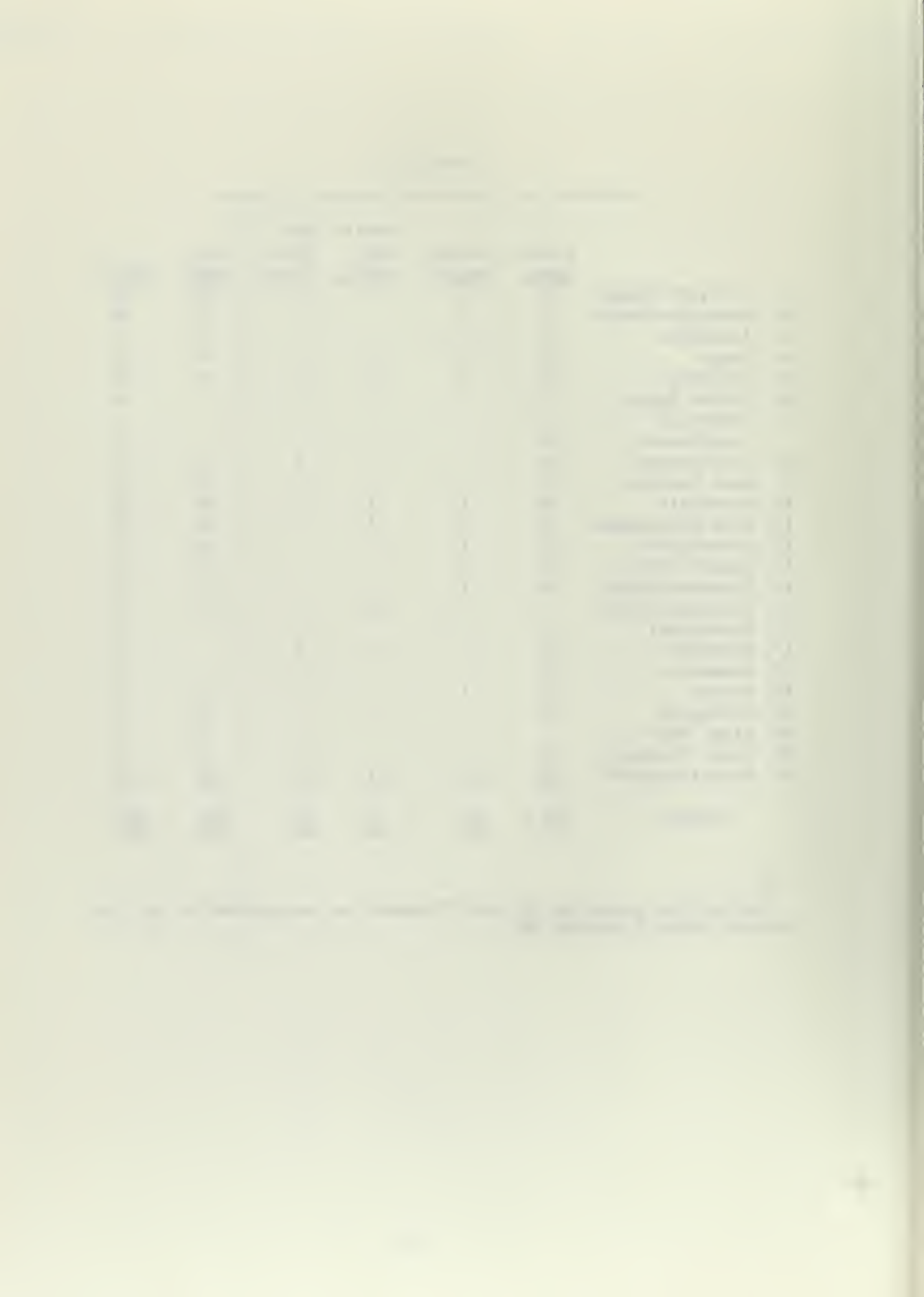
	Un-known		Indus-trial		Banks		Life Ins.		Util-ities		Mdse.	
	#	%	#	%	#	%	#	%	#	%	#	%
1. Being used	26	19.8	99	39.7	14	46.7	18	47.4	15	40.5	9	47.4
2. Definite Interest	11	8.4	26	10.4	4	13.3	3	7.9	5	13.5	2	10.5
3. Awaiting Result of study	3	2.3	6	2.4	6	20.0	7	18.4	2	5.4	-	-
4. Not Feasible	14	10.7	12	4.8	2	6.7	3	7.9	3	8.1	-	-
5. Not Being Used or No Interest	77	58.8	106	42.7	4	13.3	7	18.4	12	18.4	8	42.1
	131	100.0	249	100.0	30	100.0	38	100.0	37	100.0	19	100.0

CHART III

Breakdown of Industrial Returns by Answer

	Being Used	Interested	Awaiting Study	Not Feasible	Not Used	Total
1. Aircraft Constr.	6				2	8
2. Heavy Equipment	9	3		2	12	26
3. Aerospace	4	1			2	7
4. Drugs	7	1			4	12
5. Petroleum	9	1	2	1	4	17
6. Office Equip.	3			1		4
7. Household Appliances	2					2
8. Electronics	8			1	4	13
9. Meat Packing	1	1			4	6
10. Chemicals	4	1	1	1	4	11
11. Food Processors	3	3	1		12	19
12. Automotive	3	1			2	6
13. Metals Prod'n	5	3			7	15
14. Transportation	6	1			1	8
15. Clothing/Cloth		4	1		3	8
16. Electrical	3					3
17. Beverage	1	1		1		3
18. Cosmetics	1			1		2
19. Paper	2	1			5	8
20. Packaging	2				4	6
21. Bldg. Mtrs					5	5
22. Glass Products	2	1		1	2	6
23. Miscellaneous[2]	18	3	1	4	29	60
TOTALS	99	26	6	12	106	249

[2] Industries appearing in line 23 cannot be categorized as was the case in lines 1 through 22.



APPENDIX D

QUESTIONNAIRE FOR USE IN A SURVEY OF

THE APPLICATION OF PROGRAMMED INSTRUCTION AIDS

IN INDUSTRIAL TRAINING

1. May the information given in this questionnaire be quoted in the research paper? No attempt has been made to code any survey form.

   YES 246 Not Marked 161

   NO 97

2. If the answer to #1 is YES, please give your name, title and firm name.

3. Has your firm conducted a study into the feasibility of employing programmed instruction?

   YES 139

   NO 20

4. If YES in #3 above, what type of programmed instruction is employed?

   a) Teaching Machines Used by 88 Respondents

      1) Manufacturer See Appendix D

      2) Model

   b) Programmed textbooks 193

      1) Subjects

      2) Developed by outside source (e.g. John Jones, Consultant) 108

      3) Developed by your training department 46

      4) Purchased from publishing concern 125
         1a) Publisher
         2a) Author

c) Scrambled textbooks 25

1) Subjects

2) Developed by your training department 6

3) Developed by outside source (e.g. John Jones, Consultant) 8

4) Purchased from publishing concern 14

1a) Publisher

2a) Author

d) Other Type 9 (Taped Instruction)

1) Manufacturer or Publisher 2

2) Subjects

5. For what type of instruction is the programmed aid used? (e.g. Prudential Life Insurance Co., uses teaching kmachines for instruction of sales personnel; Hughes Aircraft uses teaching machine on electronics assembly line process; Schering Drug Corporation uses programmed textbooks for proficiency in drug knowledge for sales personnel; Bell Telephone Laboratories for introductory electricity; Humble Oil Company for service station operation training; etc.)

See Appendix G

6. Is the programmed instruction used to supplement classroom instruction or used solely by itself?

Supplement Lectures 217

Sole Instruction Aid 74

7. Has the employment of programmed instruction permitted a reduction of personnel used for training?

YES 26

NO 104

If YES. How many 59

8. Is the student allowed to proceed at his own pace?

YES 126

NO 21

9. Can you cite any results of:

a) Effectiveness or lack of effectiveness of programmed instruction vs lecture training.

b) Savings or lack of savings in training hours and/or dollars

c) Training cost per student or course of instruction with programmed aids vs other forms of training.

d) Employee attitude of lecture type training as contrasted to programmed instruction, etc.

Outstanding Examples Cited In Chapter III

10. Is the training conducted (check all that are applicable):

a) Compulsory 108

b) Voluntary 85

c) If voluntary, approximate percentage of participation 18 cited Percentages From 10% to 98% -- Average 61%.

d) On a continuing basis 61

e) Upon initial employment 52

f) Whenever an employee is introduced to a new function or process 41

g) At regularly scheduled periods 47

h) During non-working hours 43

i) During working hours 21

11. Any additional remarks, either pro or con, which you feel would contribute to the research project.
Outstanding examples cited in Chapter III.

APPENDIX E

Teaching Machines Cited As Being Used:[1]

Trade Name	Manufacturer	Type	Nr. of concerns using
1. Videosonic	Hughes Aircraft Co.	Projected Media: Key Response	8
2. AutoTutor Mark II	USI Western Design	Projected Media: Key Response	13
3. Minimax Model II	Teaching Mtrs Corporation (Grolier)	Printed Media: Written Response	16
4. Univox	Universal Electronics Laboratories Corp.	Printed Media: Written Response	1
5. Edex	Edex	Classroom Communication Sys.(4 choice resps & Automated Paper Rl)	2
6. Nortronics	Nortronics Div. of Northrop Corp.	Audio-Visual Type Machine without Response Mech'm	3
7. National Foremen	Nat'l Foremen's Institute(div of Prentice-Hall,Inc)	Printed Media: Written Response	13
8. KOG-7	Koncept-O-Graph Corp.	Printed Media: Written Response	6
9. ACS Portable	Applied Communications Sys.(Div. of Litton Sys. Inc.)	Audio-Visual Type machine without Response Mechanism	1
10. DIDAK 501	Rheem Califone Corp.	Printed Media: Written Response	1

11.	DIDAK 601	Rheem Califone Corp.	Printed Media: Key response	1
12.	Besseler-Salesmate	?	?	2
13.	Key Punch Trainee	Rheem Electronics	Computer Controlled psychomotor Device	4
14.	Auto Tutor Mark I	USI Western Design	Projected Media: Key Response	1
15.	Audio Graphic Instructor	Graflec, Inc.	Audio-Visual Type W/O Response Mechanism	3
16.	Autoguide	Radio Corp. of America	Audio-Visual Type W/O Response Mechanism	2
17.	Mast 143	Mast Dev. Co.	Linear Device Using Filmstrip & Sound w/Optional Branching	1
18.	Tachden	Aeronutronic (Div. of Ford Motor Co.)	Digital Computer Program	1
19.	Mentor	Thompson Ramo Wooldridge	Printed Media: Key Response	1
20.	Name Not Given			8
		Total concerns Using Teaching Machines		88

[1]Information regarding Trade Name; Manufacturer, and Type taken from: U. S. Department of Health, Education and Welfare. Teaching Machines and Programmed Learning. (Washington, D.C.: Office of Education, Health and Welfare, 1962. p. 35-49 and 72-80.

APPENDIX F

PUBLISHERS OF TEXTBOOKS AND SCRAMBLED TEXTBOOKS CITED IN QUESTIONNAIRE RETURNS:[1,2]

1. Basic Systems Inc.
2. Center For Programmed Instruction
3. Doubleday & Company, Inc.
4. Encyclopaedia Britannica Films
5. General Atronics Corporation
6. General Education, Inc.
7. General Programmed Teaching, Corp.
8. Hamilton Research Associates
9. Harcourt, Brace & World, Inc.
10. Holt Rinehart & Winston, Inc.
11. Institute of International Research
12. International Teaching Systems
13. Learning, Inc.
14. The MacMillan Company
15. Management Research Associates
16. McGraw Hill Book Company
17. New York Institute of Technology
18. Radio Corporation of America
19. Seminar, Inc.
20. Sigma Press
21. Science Research Associates
22. Teaching Machines Inc.
23. TOR Education, Inc.

24. Van Valkenburgh, Nooger & Neville

25. William Barton Marsh Co., Inc.

26. John Wiley & Sons, Inc.

[1]Information On Courses And Publishers is Available In: U. S. Department of Health, Education and Welfare. Teaching Machines and Programmed Learning. Washington, D.C.: Office of Education, U. S. Department of Health, Education and Welfare, 1962. p. 52-80.

[2]Many firms did not cite publishers of textbooks used and others indicated their material was developed by consultants.

APPENDIX G

Courses being taught with the aid of programmed instruction as cited in returned questionnaires:

Course	Number of concerns using
1. Vectors	1
2. Indoctrination[1]	4
3. Preliminary Job Training[1]	17
4. Retraining[1]	24
5. English/Grammar	25
6. Office Procedures[1]	80
7. Mechanical Processes[1]	6
8. Management Training[1]	34
9. Computer Programming	28
10. Sales Training (Retail & Wholesale)[1]	62
11. Customer Training[1]	7
12. Electricity	33
13. Photography	5
14. Electronics[1]	58
15. Supervisory Training	42
16. Algebra	25
17. Basic Mathematics	9
18. Geometry	7
19. Physics	6
20. Trigonometry	7
21. Safety Practices[1]	5

22.	Use of the Slide Rule	4
23.	Cost Control	15
24.	PERT/CPM	39
25.	Engineering Drawing	4
26.	Blueprint Reading	2
27.	Calculus	8
28.	Statistics	12
29.	Gyro Fundamentals/Servo Mechanisms	5
30.	Hostess Training	4
31.	Plant Protection	11
32.	Billing	7
33.	Chemistry	7
34.	PRIME	6
35.	Tax Computation	1
36.	Psychology	2
37.	Inventory Control	8
38.	Product Knowledge[1]	33
39.	Numbers	13
40.	Navigation	4
41.	Logic	1
42.	Business Data Processing Problems	3
43.	Refining Processes	4
44.	Executive Practices Programs	4
45.	Fundamentals of Human Physiology	3
46.	Armament Systems (Air Force)[2]	1
47.	TV Characteristics	2

48.	Service Station Operation Training	1
49.	Foreign Languages (Job Training)	3
50.	Foreign Languages (Off Duty Training)	2
51.	Economic Analysis	3
52.	Inertial Guidance	2
53.	Human Motivation	1
54.	SAGE Programming	1
55.	Boolean Algebra	5
56.	Basic Computer Technology	3
57.	Fleet Balistics Missile Mechanics (U.S. Navy)[2]	1
58.	Sonar Operator Sounds (U.S. Navy)[2]	1
59.	Radio Code (U.S. Navy)[2]	1
	Total Courses Reported	712

[1]For the sake of brevity many programs have been included under a general heading. (e.g. Office Procedures includes filing, key punch operation, accounting, clerical machine operation, credit practices, switchboard operation, etc.; Sales Training includes such diverse industries as drug, insurance, rubber products, etc.).

[2]Both the United States Navy and United States Air Force have many more courses that employ programmed instruction but they have been included under general titles such as electronics, electricity, computer programming, inventory control, etc.